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The purpose of this study was to test the effectiveness ot two training sequences designed to increase auditory discrimination in preschool educationally disadvantaged children. Auditory discrimination is important because, among other reasons, studies have shown the existence of a high positive correlation between a child's ability to listen and his ability to read. It was hypothesized that the environment of disadvantaged youth produces so much noise that a blocking of individual sounds occurs. One hundred and six Head Start children took part in this study. The first training group listened to tapes containing 12 categories of sounds familiar to children. The second training group listened to narrative materials played on tape recorders. Posttraining test scores showed that group one children performed better than group two children for both verbal discrimination and following directions. Both training groups performed better than the control group, and girls generally performed better than boys. (WD)

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An Experimental Program Designed to Increase Auditory Discrimination with Head Start Children

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The improvement of reading or the improvement of a child's potential ability to learn to read fits into the schemata suggested by Jensen. Auditory discrimination, the degree to which an individual is capable of categorizing sound stimuli in a meaningful way and respond to that stimuli has been related to the ability to read in studies done by Biggins, Bonner, Canfield, Haberland, Holmes and Singer, Plessas, and Vineyard. The studies cited indicate that a consistently high positive correlation exists between a child's ability to listen and his ability to read.

Methods of increasing auditory discrimination in young children have been suggested by several authors. The purpose of the present study was to test the effectiveness of two training sequences designed to increase auditory discrimination in pre-school educationally disadvantaged children. It was assumed that learning styles, auditory and visual, do exist as some authors have suggested.

If these styles could be defined and identified in young children, then certain assumptions concerning compensatory education could be verified. Pre-school training is not new but prior to 1961 it was largely directed toward middle class children or children of working mothers. Deprivation studies such as those done by Scott, Rozenzweig, and Dennis tend to indicate that environment and experience contribute to the development of the child. A review of the literature by Sears and Dowley indicates that for middle class children, the former target of pre-school training, there is little or no difference on any characteristic or dimension between control and experimental groups due to treatment

by the beginning of third grade. The type of pre-school training considered in this review could be categorized as traditional, the meeting of childrens' needs as these needs emerge. A new direction for pre-school education evolved from the 1961 convention of the AAMD. The concept of pre-school intervention intended to correct intellectual deficiencies of educationally disadvantaged children was to be the new directing concept. Kirk's study of mentally handicapped children suggests that the handicapped or culturally deprived may be directly or permanently aided by pre-school experience. Bloom has suggested that intellectual development before the age of four years may be the most vital and, therefore the optimal time for training. Jensen,however, contends that attempts to raise IQ as such in compensatory programs is an inappropriate approach and he recommends specific training designed to increase the potential academic achievement of the child. This requires the design of curricula that will directly boost school performance.

For the sample under consideration, the educationally disadvantaged, it was assumed that less than average ability to discriminate auditorily would be found. It was hypothesized that children who lived in multiple-unit public supported housing would have experienced almost continuous bombardment of sound stimuli. The sounds of many televisions and radios, people in nearby poorly insulated dwelling units, and overcrowding would combine to produce a "white noise", a combination of multiple sounds. It can further be assumed that the child from this

environment might respond to this form of white noise exactly as does the subject in a laboratory situation. A blocking of individual sounds would occur. If auditory discrimination is a developmental task as Strickland and Fessenden contend and if the children from this population have not had some opportunity to learn to isolate and identify individual sounds as the middle class children might have had then it is unlikely that they would be capable of discriminating auditorily to the same degree. If this ability is indeed related to the ability to learn to read then it may be necessary to conduct extensive listening and sound discrimination training for these children. The period of compensatory education provided by the Head Start and Follow Thru programs offers an opportunity for this type of training.

The Sample

One hundred and six Head Start children from six Head Start groups in a large southwestern city participated in the study. An author-constructed auditory recognition test ($r = .843$) and the Raven's Coloured Progressive Matrices Test, defined for the purpose of this study as a test of visual discrimination, was administered to each subject (Ss). Standard scores of Ss on each of the tests and difference scores were then computed. Auditory learners were then defined to be those children whose difference score between

auditory and visual tests was .931 or greater, visual learners were defined as those children whose difference scores were -.834 or less, and the remainder were categorized as auditory-visual learners.

Two treatment groups and a control group were randomly selected after stratified blocking on learning style and sex.

Method

Two hypotheses were tested.

I. No differences in scores will exist on a criterion measure for operationally defined auditory, visual, or auditory-visual learners after treatment. A 3 x 3 x 2 (treatment group, by learning style, by sex) factorial design was used to test this hypothesis. Analysis of variance and analysis of covariance (readiness as measured by the Lee-Clark Reading Readiness Test) were used. These are fixed model designs and interactions as well as main effects were considered.

II. Auditory discrimination is a developmental skill and as such it can be increased by a planned training sequence. A 3 x 3 x 2 (treatment, by ability level, by sex) factorial design was used to analyze data. Analysis of variance and analysis of covariance (age in months) techniques were used to analyze data. These are fixed model designs and interactions as well as main effects were considered.

The first treatment group listened to eighteen training sequences presented on magnetic tape. The tapes required eight to fourteen minutes to complete and were administered to groups of three to six children. Each item was programmed: it was introduced;

cues were provided; the stimuli were presented; time was allowed for response; and feedback was provided. Items were generated from twelve categories of sound stimuli with which children of this age should be familiar. Each class of stimuli was represented by an equal number of items randomly distributed over the eighteen sequences.

The second experimental treatment was an attempt to emulate the listening period technique used by the majority of kindergarten and first grade teachers. Narrative materials of an appropriate level and of a length similar to the instructional sequences was presented on magnetic tape to groups of three to seven children.

Results

The criterion measure was an author-constructed test designed to measure three aspects of auditory discrimination: Recognition and classification of sound stimuli with which children of this age might be familiar; verbal or language stimuli; and responding to simple directions.

Table 1 gives results for analysis of covariance for the primary analysis (treatment by learning style, by sex). This analysis was done utilizing the CDC6400 computer at the University of Colorado and the BMD05V Computer Program (1965) as modified by Peckham (1967). Homogeneity of variance was computed by a test of the F value when the two most extreme cell variances were compared ($F_{max} = 2.71$, $p < .05$). Table 1 shows consistent significant differences resulting from treatment effects favoring the treatment groups. Learning style and sex differences were significantly different for following directions. When learning style

groups were equated on the covariate of reading readiness this difference disappeared. However, significant differences were still present for the effect of sex after groups had been equated on the covariate. Therefore, it is evident that a sex difference, favoring girls, did exist.

Table I

F-RATIOS AND ERROR MEAN SQUARES FOR THE ANALYSIS OF VARIANCE AND COVARIANCE FOR THE PRIMARY DESIGN

Source of Variation	df	Sound Discrimination Variance	Sound Discrimination Covar.[b.]	Verbal Discrimination Variance	Verbal Discrimination Covar.[b.]	Following Directions Variance	Following Directions Covar.[b.]	Total Score Variance	Total Score Covar.[b.]
Treatment	2	13.89**	17.55**	9.50**	11.05**	28.40**	32.29**	21.34**	26.13**
Style[a.]	2	2.74	.03	1.11	.05	5.33**	1.03	3.55	.16
Sex	1	.58	1.01	.24	.41	4.46*	5.48**	1.55	2.30
Treatment x Style	4	.22	.52	.08	.18	.25	.42	.14	.38
Treatment x Sex	2	.28	.29	.01	.01	1.23	1.33	.18	.20
Style x Sex	2	.30	.11	.30	.45	3.09	4.02*	.76	1.19
Treatment x Style x Sex	4	.12	.20	.10	.21	.18	.31	.14	.29
Error Mean Square	78	4.56		5.56		3.87		30.98	
Error Mean Square	77		3.99		5.22		3.59		27.32

a. Auditory, visual, or auditory-visual learning style.

b. Raw score on the Lee-Clark Reading Readiness Test.

* $p<.05$

** $p<.01$

Adjusted marginal mean values for the analysis of variance and covariance are given in Table 2.

Although the analysis of variance and covariance indicated significant differences between treatment means it was necessary to use the Newmann-Kuels (Winer, 1962) multiple range test to identify particular differences that evidenced significance. It was found that both treatment groups were superior at the .01 level to the control group for all part scores and the total score. The differences between Treatment I and Treatment II were significant for verbal discrimination in the analysis of variance. In the analysis of covariance, Treatments I and II were significantly different for both sound and verbal discrimination.

Table 2

MARGINAL ADJUSTED MEAN VALUES FOR ANALYSIS OF VARIANCE AND COVARIANCE FOR THE PRIMARY DESIGN

Dependent Variable	Treatment I	Treatment II	Control	
Analysis of Variance				
Sound Discrimination	10.3939	9.0619	7.0974	I II C[a.]
Verbal Discrimination	9.8491	8.4841	7.1935	I II C
Following Directions	9.9685	9.0322	6.5174	I II C
Total Score	30.2133	26.7819	21.0000	I II C
Analysis of Covariance				
Sound Discrimination	10.4723	9.0805	7.1883	I II C
Verbal Discrimination	9.9125	8.8592	7.1105	I II C
Following Directions	10.0257	9.0458	6.4425	I II C
Total Score	30.4123	26.9855	20.7393	I II C

a. Any two values not underscored by the same line differ significantly ($p < .01$).

The auxiliary design tested the second hypothesis, that auditory discrimination is a skill, developmental in the sense that it is increased by practice and use, and the skill can be increased by a planned training sequence. Blocking was done on ability level, as measured by the Lee-Clark Reading Readiness Test raw score, and on sex. Assignment to treatment groups had been done in the primary analysis so stratified randomization at this point was not possible. Disproportionality existed among cells as a result of original assignment to treatment groups and was restored by randomly casting out cases from large cells and adding mean values to small cells as suggested by Lindquist (1953).

Table 3 gives the results for each part score and the total score. This table shows consistent signifcant differences resulting from treatment effects, favoring treatment groups, and ability level, favoring higher ability children. Sex differences were significant for following directions in the analysis of variance but the F-ratio was less than significant when the variable of age was used as a covariate. This result is consistent with the analysis of data from the primary design and offers further confirmation of the assumption previously stated that sex differences favoring girls do exist for this type of item.

Table 3

F-RATIOS AND ERROR MEAN SQUARES FOR THE ANALYSIS OF VARIANCE AND COVARIANCE FOR THE AUXILIARY DESIGN

Source of Variation	df	Sound Discrimination Variance	Sound Discrimination Covar.[b.]	Verbal Discrimination Variance	Verbal Discrimination Covar.[b.]	Following Directions Variance	Following Directions Covar.[b.]	Total Score Variance	Total Score Covar.[b.]
Treatment	2	16.88**	18.28**	12.09**	12.03**	28.81**	29.77**	25.83**	25.86**
Ability[a.]	2	16.35**	15.45**	4.19*	4.01*	12.90**	12.59**	13.80**	13.23**
Sex	1	.16	.01	.20	.14	4.85*	3.85	1.41	.92
Treatment x Sex	4	.57	.47	.19	.13	.63	.51	.39	.25
Treatment x Ability	2	.85	.53	.14	.16	.53	.70	.02	.04
Ability x Sex	2	1.46	1.95	.44	.44	3.83*	4.20*	1.28	1.57
Treatment x Ability x Sex	4	.39	.67	.27	.31	.85	1.11	.46	.69
Error Mean Square	75	3.16		4.55		3.20		22.63	
Error Mean Square	74		3.09		4.50		3.18		22.45

a. Raw score on Lee-Clark Reading Readiness Test.

b. Age in months.

* $p < .05$

** $p < .01$

Since the more stringent requirements of the analysis of covariance did not have to be met, analysis of variance results are more generalizable for both designs. It should be noted that the number of interactions found to be significant in both designs can be assumed to be due to chance at the .05 level by definition.

Adjusted marginal mean values for the analysis of variance and covariance are given in Table 4. The Newmann-Kuels multiple range test was employed to identify particular differences that evidenced significance. Both treatment groups were superior at the .01 level to the control group for all part scores and the total score. The differences between Treatment I and Treatment II were significantly different and favored Treatment I for verbal discrimination and following directions for both analysis of variance and covariance. Treatment I was significantly different than Treatment II for Total Score in the analysis of variance.

Table 4

MARGINAL ADJUSTED MEAN VALUES FOR ANALYSIS OF VARIANCE AND COVARIANCE FOR THE AUXILIARY DESIGN

Dependent Variable	Treatment I	Treatment II	Control	
Analysis of Variance				
Sound Discrimination	10.19	9.07	7.22	I II C[a.]
Verbal Discrimination	9.94	8.64	7.09	I II C
Following Directions	9.72	8.29	6.72	I II C
Total Score	29.85	26.79	20.80	I II C
Analysis of Covariance				
Sound Discrimination	10.18	9.13	7.18	I II C
Verbal Discrimination	9.94	8.46	7.07	I II C
Following Directions	9.71	8.32	6.44	I II C
Total Score	29.83	26.92	20.70	I II C

a. Any two values not underscored by the same line differ significantly ($p < .01$)

Summary

Consistent significant differences favoring treatments existed in both the primary (learning style) and auxiliary (ability level) designs. Ability level, favoring higher ability children, provided consistently significant differences in the auxiliary design. No interaction effects beyond the chance number expected were significant.

Treatment 1 (programmed practice items) was superior ($p<.01$) to Treatment 11 for verbal discrimination in the primary design. Treatment 1 was superior to Treatment 11 ($p<.01$) for both verbal discrimination and following directions in the auxiliary design.

Auditory discrimination, as measured by the prepared criterion, can be increased by a sequence of planned listening activities designed for children of the defined population. If practice in attending to individual sound stimuli is prerequisite to achieving proficiency in classifying and categorizing classes of sound stimuli, the definition of auditory discrimination for this study, then either treatment is superior to no treatment and Treatment 1 is superior to Treatment 11 for verbal discrimination and following directions.

Recommendations for Further Study

Further research is needed to determine the most advantageous time for training of this type. The results of this study certainly offer strong evidence in support of early training. However, these results must be considered to be incomplete since longitudinal aspects of the training and retention tests were beyond the scope of this study.

The concept of attending to stimuli, both auditory and visual,

needs further theoretical and experimental consideration, particularly with respect to compensatory pre-school education. The problems encountered by children classified as culturally deprived or culturally different in public schools may be highly related to problems of attending to stimuli in an efficient manner. The middle class child who lives in a relatively well-ordered, less confused, less congested, and quieter environment may achieve greater success in school because he is accustomed to attending to one stimulus at a time rather than being bombarded by conflicting stimuli. For example, the middle class child is used to listening to the voice of one adult at a time, playing alone or with fewer children at a time, and even watching television with less conflicting background noise. Attending to individual sound stimuli at an early age and continuous practice in attending may allow the child to function adequately in the school environment where the role of attention has not been thoroughly defined.

Further examination of the effectiveness of programmed instruction with young children is needed. If the role of attending is a major factor and if the lower class child, the child at which compensatory education is directed, has had little experience in attending, programmed instruction with the emphasis on directed attention may be the most effective teaching method for these children.

The tape medium and similar types of learning experiences could be of value in teaching other forms of learning problems. The brain damaged and emotionally disturbed form major groups of problem learners who have particular difficulty with attending in

the school situation. It would be of interest to test the degree to which problem learners could generalize their ability to attend to sound stimuli, following treatment, to other areas of school work which require attention to individual stimuli.

More generally, a definitive study of compensatory programs, specifically Head Start Programs is definitely needed. The only way such an expenditure can be justified indefinitely is to perform a well-controlled, well-designed longitudinal study that will show that definite improvement can be attributed to early compensatory education of the disadvantaged.

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